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TEST SECTION INF BD

REPORT

of

The Infantry Board

No. 1896

SABOT AMMUNITION FOR THE 57MM GUN, M1, (AT)

FORT BENNING, GEORGIA

30 SEP 1945

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IB-471 THE INFANTRY BOARD

Fort Benning, Georgia
30 September 1945

SUBJECT: Sabot Ammunition for the 57mm Gun M1 (Antitank)

THROUGH: The Commandant, The Infantry School, Fort Benning, Georgia

TO: The Commanding General, Army Ground Forces, Washington 25, D. C.

1. References.

Letter from AGF to TIB dated 6 May 1945 directing tests and inclosure thereto. (Appendix "B")

2. Description of Materiel.

a. The subject ammunition is British Standard for the 6 Pounder which is identical with the U.S. 57mm AT gun except for design details.

b. Except for the projectile, the ammunition is identical with the M86, APC and M70 AP rounds for the 57mm AT gun.

c. The projectile for the subject ammunition consists of the following principal parts:

(1) An AP slug of about 37mm diameter which carries a tracer element in its base.

(2) A pusher plate assembly consisting of a steel plate into which the base of the slug assembles, a gas seal in the form of a plastic cup, and a rotating band attached to the forward section of the steel plate.

(3) A hollow aluminum sleeve partially split longitudinally at 120° intervals which surrounds the slug. It extends from about the midpoint of the ogive of the slug to the forward section of the pusher plate. The outer contour of the sleeve consists of an ogive at the forward portion, terminating in a bourrelet which is followed by a reduced diameter cylindrical portion extending to a partially split annular rear section by which the sleeve is attached to the pusher plate to hold the projectile assembly together.

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d. After the projectile leaves the tube the sleeve separates into four pieces, at the longitudinal splits and the partial peripherial split in the rear annular section. The three forward sections are projected tangentially away from the slug releasing it from the pusher plate assembly and rear sleeve section which follow the slug in direction but at lower velocity.

3. Factual Background.

a. A letter from the British Army Staff, Washington, D. C. to personnel at Headquarters AGF (Incl. 1, reference paragraph 1.) constitutes the only information available to the Board relative to the subject sabot ammunition. The sabot principle is not new and ammunition of the sabot type has been used periodically for many years.

b. Recent types of U.S. armor-piercing sabot ammunition are covered in TIB Report No. 1740. These types (105mm with 3" and 75mm AP shot) were not considered satisfactory due to fit in the weapon, danger area covered by sabot fragments, and firing reactions in the 105mm howitzer carriage. The Board recommended further development of the projectile to reduce carriage reactions to the degree necessary for satisfactory functioning.

4. Facts Shown by Tests.

a. The subject ammunition is shorter and lighter than cartridge Caliber 75mm AP M70, the difference being in relative weight of the projectiles. (Test No. 1)

b. Accuracy is slightly less than that of standard ammunition (M70) but compares well with it. (Test No. 2)

c. The danger area for fragments of the sabots covers a segment of about 240 mils extending to the front of the gun for about 250 yards. This area does not include the greater area covered by the pusher plates, none of which was recovered. (Test No. 3)

d. The firing reactions on the 57mm Gun and carriage are about the same as those of standard ammunition. No damage to the bore was noted. (Tests Nos 4, 5 and 6)

e. Primers for the subject ammunition are not dependable, only 50% functioning on first action of the firing pin. About 14% of the rounds were rejected because of complete primer failures. (Test No. 6)

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f. Of the 36 rounds fired, twelve tracer elements separated from the projectile in flight at about 300 yards in front of the muzzle, starting grass fires. The tracer is comparable to a .45 caliber tracer and is visible to the gun crew for about 1500 yards. (Test No. 6)

g. No facilities were available for testing the ammunition against armor plate, and no penetration tests were conducted.

5. Discussion. In comparing the results of tests of the 105mm types of sabot ammunition with the reported performance of the subject ammunition, cognizance should be taken of the fact that the former reached velocities of only 2000 f/s, whereas velocities of 4000 f/s are reported for the latter. The penetration reported by the British compares with that of U.S. standard APC slugs fired from a 90mm gun. Such penetrations, provided the accuracy and maneuverability of the 57mm gun makes it suitable as an antitank weapon, meet a long standing Infantry requirement for ammunition to be used against tank armor. In arriving at a decision as to the best type of ammunition to be used for antitank missions, the subject ammunition fired from the 57mm antitank gun should be considered along with shaped charges fired from launchers and recoilless weapons, and sabot ammunition fired from the latter.

6. Conclusions. The Infantry Board concludes:

a. That the subject armor-piercing sabot ammunition is satisfactory for use in 57mm antitank guns, insofar as range, accuracy, and effect upon the gun and carriage are concerned.

b. That the tracer is satisfactory in its functioning but that the method by which it is attached to the armor-piercing slug is unsatisfactory.

c. That the fragments from the sabots of the subject ammunition are a hazard to friendly personnel and limit its use for overhead fire.

d. That further tests of the ammunition are necessary to determine its armor plate penetration, and its combat value to the Infantry compared with that of similar ammunition and shaped charges used in other Infantry weapons.

e. That further action regarding this ammunition is contingent upon the future status of the 57mm antitank gun.

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7. Recommendations. The Infantry Board recommends:

a. That proving ground tests be conducted to determine the armor plate piercing characteristics of the subject ammunition, compared with those of rockets and recoilless weapons ammunition employing shaped HE charges.

b. That if the penetration characteristics of the ammunition are satisfactory, further action be taken looking to its adoption only in the event that the 57mm antitank gun is to be retained.

c. That consideration be given to adapting the subject sabot ammunition, or ammunition based on the same principles, to use in present, standard 57mm and 75mm recoilless rifles, to achieve high-velocity, flat trajectory fire against armored vehicles, concrete pillboxes and other emplacements against which the ordinary High Explosive Antitank (HEAT) shell is not effective.

INGOMAR M. OSETH,
Colonel, Infantry,
President.

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RECORD of TEST

ON

SABOT AMMUNITION FOR THE 57MM GUN, M1 (ANTI-TANK)

TEST SECTION
THE INFANTRY BOARD
FORT BENNING, GEORGIA

TO: THE DIRECTOR, THE INFANTRY BOARD.
HEREWITH DETAILED RECORD OF TESTS
RELATING TO THE ABOVE PROJECT.

EDWARD B. CROSSMAN
Lt. Colonel, Infantry
TEST SECTION EXECUTIVE

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.....8.....Copies.

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Date SEP 29 1945

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1. Authority.

a. Memorandum, The Infantry Board, IB-471, 16 May 1945. (Appendix "A")

b. Letter, Ground Requirements Section, Headquarters Army Ground Forces, 471 (C) (6 May 1945), GNRQT-11/25397, 6 May 1945, with one indorsement and one inclosure. (Appendix "B")

2. Introductory Information.

a. The 57mm Sabot Ammunition is to be tested in the 57 Gun M1 to verify the reports from European Theatre of Operations that American Troops had successfully used the subject round to knock out heavy German tanks.

b. The subject round is standard for the British. The 57mm Sabot Ammunition is similar to that recently tested for the 105mm Howitzer.

The Sabot principle employs a light compound projectile, composed of an armor piercing slug that is mounted in a frame of metal in order to function in the bore of the weapon being fired. In the case of the subject ammunition a small slug of about 37mm size is mounted in a frame of aluminum alloy that is fitted onto a pusher plate composed of steel and plastic. The plastic is a cup-shaped skirt which expands and becomes a gas seal upon firing. Upon firing the shell moves to the muzzle of the weapon as a unit but disintegrates at the muzzle and the slug continues in flight while those irregular portions of the projectile fall off rapidly. (See Figures 1, 2 and 3)

c. The use of this round allows a light projectile of higher than normal muzzle velocity to be fired from the weapon without excessive abuse to the weapon. This higher velocity of the projectile increases the effective range of point blank fire and decreases the lead necessary when firing at moving targets.

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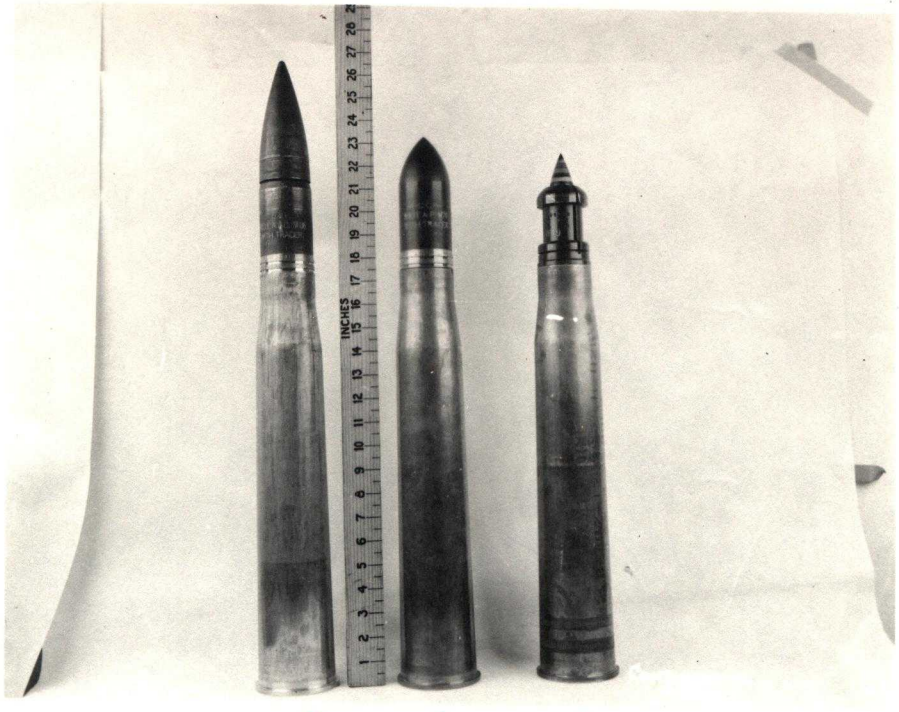

57mm AP Ammunition

a - M86 - APC

b - M70 - AP Shot.

c - T19753 - Sabot (British)

Figure 1

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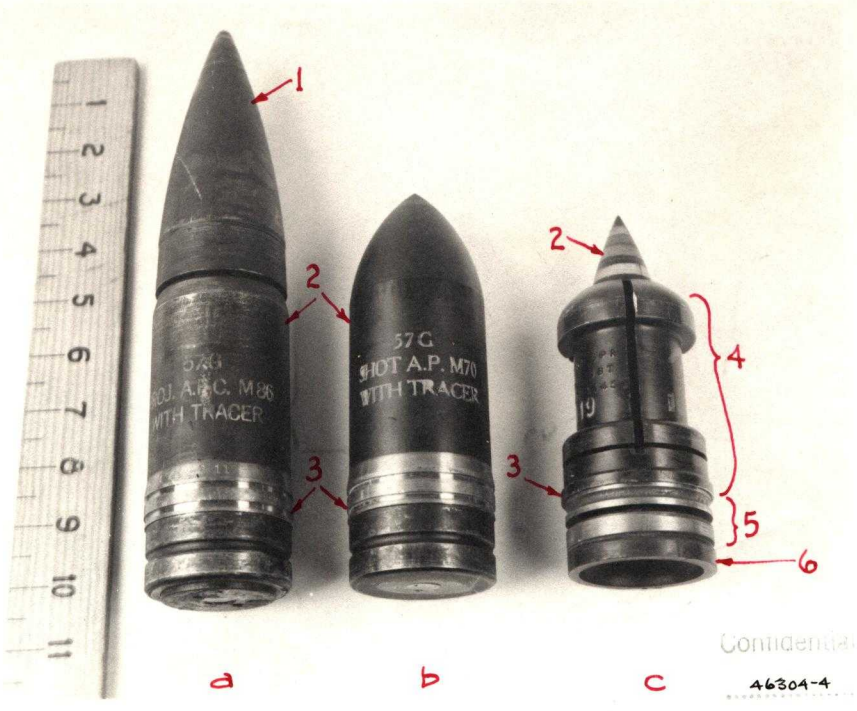

57mm AP Projectiles

a - M86 - APC.
b - M70 - AP Shot.
c - T19753 - British Sabot.

1 - Windshield.
2 - AP Slug.
3 - Turning Band.
4 - Aluminum disintegrating superstructure.
5 - Steel pusher plate.
6 - Plastic gas seal.

Figure 2

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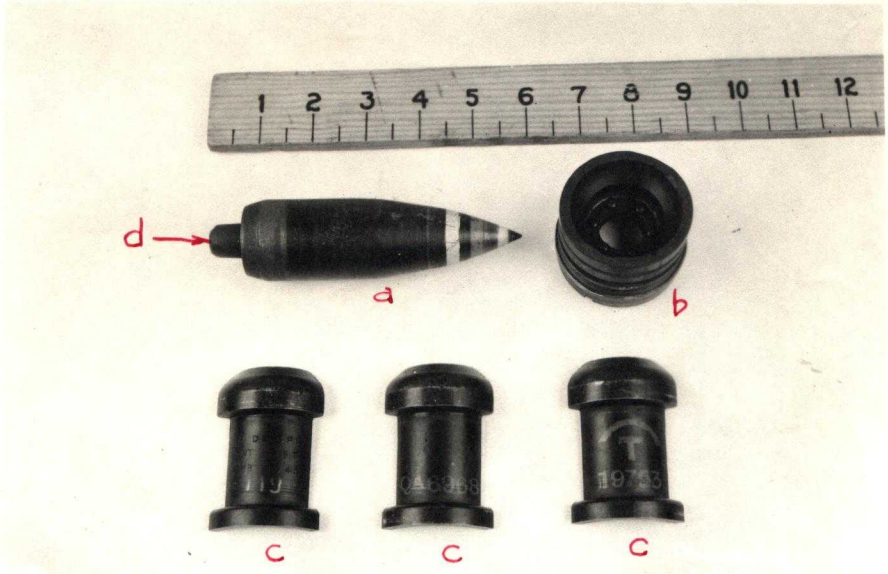

57mm Sabot (British) components as disintegrated by firing.

a - SP Slug.
b - Pusher plate section of superstructure.
c - Segments of superstructure.
d - Tracer element.

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Figure 3

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3. Purpose of Test.

a. Physical characteristics of subject and standard ammunitions for the 57mm Gun M1.

b. Accuracy of subject and standard ammunition.

c. Danger area caused by fragments of Sabot ammunition.

d. Stability of the gun when firing the subject and standard ammunitions.

e. Damage to gun caused by Sabot ammunition.

f. Comparative sight settings necessary to hit targets at the same range when firing the subject and standard ammunitions.

g. Other pertinent data.

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4. Details of Tests and Results.

Test No. 1

a. Purpose: To compare the physical characteristics of the 57mm Shells, M70, M86 and T19753.

b. Method: By inspection, measuring, weighing and photographing.

c. Results:

(1) See photographs (Figures 1, 2 and 3).

(2) Critical information:

	Ammunition		
	M86	M70	Sabot
Length of complete round (in.)	26.31	23.06	22.19
Weight of complete round (lbs.)	12.90	12.43	10.06
Length of projectile before firing (in.)	10.38	6.81	6.13
Weight of projectile before firing (lbs.)	6.76	6.29	3.25
Length of ballistic projectile after firing (in.)	10.38	6.81	5.54
Weight of ballistic projectile after firing (lbs.)	6.76	6.29	2.25
Diameter of ballistic projectile after firing (in.)	2.24	2.24	1.48
Muzzle velocity (ft/sec.)	2700	2800	4000
Weight of full ammunition container (lbs.)	84.9	82.5	107.75
Number of rounds in container	4	4	6
Average weight per round of packaged ammunition (lbs.)	21.2	20.6	14

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Test No. 2

a. Purpose: To compare the accuracy of the subject ammunition and standard ammunition M70.

b. Method:

(1) Ten (10) rounds of each type of ammunition were fired at a "B" Target centered on a 6' x 6' wood panel.

(2) Firing was conducted at ranges of 500, 1000 and 1500 yards.

(3) The weapon was carefully bore-sighted before the test started.

(4) Adjusting rounds were fired for each type of ammunition for range deflection before firing the shot group and the range in the telescopic sight noted. The sight setting was not disturbed after the gun was bore-sighted.

(5) Lateral and vertical dispersion from the center of the target panel were measured by instrument at the gun position and hits on the target panel were counted.

c. Results:

(1) Fire data.

Type of Ammunition	Round No.	Range (Yds)	Sight Setting (Yds.)	Distance of Hit from Center of Target (inches) Lateral	Vertical	Remarks
M70	1	500	500	0	19 low	hit
	2			0	19 low	hit
	3			0	19 low	hit
	4			3 left	23 low	hit
	5			5 right	17 low	hit
	6			0	21 low	hit
	7			2 right	20 low	hit
	8			6 right	18 low	hit
	9			0	15 low	hit
	10			2 left	24 low	hit
Distance, center of target to center of impact (inches):				.8 right	19.5 low	

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Type of Ammunition	Round No.	Range (Yds)	Sight Setting (Yds.)	Distance of Hit from Center of Target (inches) Lateral	Vertical	Remarks
T19753 (Sabot)	1	500	Bore sight mark 36" above center of target.	14 left	7 high	hit
	2			4 right	17 high	hit
	3			18 left	9 high	hit
	4			12 left	46 high	miss
	5			29 left	26 high	hit
	6			38 left	7 high	miss
	7			32 left	6 low	hit
	8			14 left	12 low	hit
	9			10 left	12 high	hit
	10			16 left	16 high	hit
Distance, center of target to center of impact (inches):				17.9 left	12.2 high	
M70	1	1000	1200	48 right	24 high	miss
	2			40 right	12 high	miss
	3			25 right	34 low	hit
	4			32 right	60 high	miss
	5			15 right	33 high	hit
	6			22 left	32 high	hit
	7			60 right	36 low	miss
	8			48 right	12 low	miss
	9			16 left	60 high	miss
	10			8 right	26 low	hit
Distance, center of target to center of impact (inches):				23.8 right	11.3 high	
T19753 (Sabot)	1	1000	200	12 left	48 low	miss
	2			48 left	24 low	miss
	3			40 left	12 low	miss
	4			16 left	18 low	hit
	5			60 left	48 high	miss
	6			12 left	60 high	miss
	7			0	48 high	miss
	8			24 left	38 low	miss
	99			31 left	26 low	hit
	10			12 left	48 high	miss
Distance, center of target to center of impact (inches):				25.5 left	3.8 high	

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Type of Ammunition	Round No.	Range (Yds)	Sight Setting (Yds.)	Distance of Hit from Center of Target (inches) Lateral	Vertical	Remarks
M70	1	1500	1600	2 right	4 low	hit
	2			28 right	8 low	hit
	3			48 right	36 low	miss
	4			15 right	10 low	hit
	5			36 right	48 low	miss
	6			24 right	48 high	miss
	7			36 right	60 high	miss
	8			11 right	15 low	hit
	9			7 right	31 low	hit
	10			37 right	28 low	hit
Distance, center of target to center of impact (inches):				24.4 right	7.2 low	
T19753 (Sabot)	1	1500	350	72 left	48 low	miss
	2			108 left	12 high	miss
	3			60 left	24 low	miss
	4			31 left	11 low	hit
	5			12 left	72 low	miss
	6			48 left	60 low	miss
	7			48 left	0	miss
	8			60 left	24 high	miss
	9			96 left	60 low	miss
	10			60 left	24 low	miss
Distance, center of target to center of impact (inches):				59.5 left	26.3 low	

Note: All the 1000-yard firing was conducted in the moring under poor light conditions.

Test No. 3

a. Purpose: To determine the danger area of the fragments of the Sabot ammunition.

b. Method:

(1) Six, 6' x 6' wood panels were placed 25 yards in front of muzzle of the 57mm gun.

(2) One round was fired through the center of the panels and the fragment pattern noted.

(3) Ten rounds were fired over the center of the panels and the fragment pattern noted.

(4) The area in front of the gun was searched and the range to the fragments measured.

(5) The condition of the fragments was noted for separation in the gun other than at desired points.

c. Results:

(1) At 25 yards the pusher plate was 2" off center from the AP slug. Two of the three forward segments struck the board panels and made perforations.

(2) During the firing of 10 rounds of Sabot ammunition, 16 forward segments and two pusher plates struck the wood panels over an arc 18' wide at 25 yards or 240 mils.

(3) Twelve of the forward segments were found within 250 yards of the gun position. Most of these segments were in a 10- yard strip at that range. None of the pusher plates were found in a search of an area 500 yards to the front of the gun. It is believed that this is partly due to its partial steel construction having a much greater range than the aluminum segments recovered.

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Test No. 4

a. Purpose: To compare the jump and displacement of the 57mm Gun M1 when firing the M70 and the subject Sabot ammunition.

b. Method:

(1) By observation and measurement of the jump and displacement of the weapon as fired.

(2) Ten rounds of each type ammunition were fired with the spades emplaced with logs to restrict displacement to the rear.

(3) Ten rounds of each type ammunition were fired with the spades unrestricted in a loam soil that had been cultivated within the past five years.

c. Results:

(1) Displacement restricted.

(a) When firing both types of ammunition, the weapon rebounded off of the logs about six inches.

(b) The Sabot ammunition made the wheels leave the ground approximately 3.5" while the M70 ammunition made the weapon jump approximately 3".

(2) Firing from loam soil.

(a) No difference in displacement could be noted when the two types of ammunition were fired from the weapon under similar conditions. Both types of ammunition displaced the weapon 25.5 inches in 10 rounds.

(b) Under these conditions no difference in jump was noted in the gun when firing the two types of ammunition. Both types of ammunition made the wheels leave the ground approximately 2-1/2 inches.

(3) There appeared to be no difference in recoil of the tube when firing the two types of ammunition.

(4) There was no noticeable difference noted by the gunner when firing the two types of ammunition.

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Test No. 5

a. Purpose: To determine if the subject Sabot ammunition will damage the bore of the 57mm Gun M1.

b. Method:

(1) The bore of the weapon used in firing this test was inspected carefully before, during and after firing.

(2) The gun was inspected externally to determine if the mechanism had been damaged by the firing of the subject ammunition.

c. Results: The weapon used in this test appeared to be in the same condition at the end of the test firing that it was when firing began.

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Test No. 6

a. Purpose: To tabulate defects noted during the firing of the subject ammunition.

b. Method: By observation of firing.

c. Results:

(1) Failures to fire.

Rounds Attempted to Fire	Fired 1st try	Fired 2nd try	Fired 3rd try	Rejected after 3rd try
42	21	13	2	6

(2) Defective tracer element.

Twelve tracer elements left the Sabot projectile and started fires within 300 yards of the gun position and generally in line with the target. This element was as bright as a .45 caliber tracer and was visible to the target crew 1500 yards away as it left the muzzle of the weapon.

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5. Summary of Facts.

a. Critical information: (Test No. 1)

Type of shell	M86	M70	Sabot
Length of complete round (in.)	26.31	23.06	22.19
Weight of complete round (lbs.)	12.90	12.43	10.06
Length of projectile before firing (ins)	10.38	6.81	6.13
Weight of projectile before firing (lbs.)	6.76	6.29	3.25
Length of ballistic projectile after firing (in.)	10.38	6.81	5.54
Weight of ballistic projectile after firing (lbs.)	6.76	6.29	2.25
Diameter of ballistic projectile after firing (in.)	2.24	2.24	1.48
Muzzle velocity (ft/sec.)	2700	2800	4000
Weight of full ammunition container (lbs.)	84.9	82.5	107.75
Number of rounds in container	4	4	6
Average Weight per round of packaged ammunition (lbs.)	21.2	20.6	14.

b. The dispersion of the Sabot slug is slightly greater than that of the M70 slug at 500, 1000 and 1500 yards but is not excessive. (Test No. 2)

The Sabot slug has approximately 1.5 mils less drift to the right than the M70 slug. (Test No. 2)

The sight settings of the M70 and Sabot ammunition are as follows:

Range (Yds.)	Sight Settings for Ammunitions M70	Sabot
500	500	Bore sight mark 36" above center of target
1000	1200	200
1500	1600	350

(Test No. 2)

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c. The aluminum segments of the Sabot frame travel about 250 yards forward of the gun and are within an area approximately 120 mils on either side of the line of fire. No trace was found of the pusher plate; however, it is believed to go much further and in the general direction of the slug. (Test No. 3)

d. The displacement and jump of the 57mm Gun M1 is approximately the same when firing the M70 and Sabot types of ammunition. (Test No. 4)

There appeared to be no difference in the recoil of the tube of the weapon when firing these two types of ammunition. (Test No. 4)

The gunner did not notice any difference in the feel of the gun when firing the two types of ammunition. (Test No. 4)

e. The Sabot ammunition apparently does not injure the 57mm Gun M1. (Test No. 5)

f. The primers in the Sabot ammunition are not dependable when used in the 57mm Gun M1. (Test No. 6)

The tracer elements of the Sabot ammunition separated from the AP slug in about 30% of the rounds and started fires in front of the gun within 300 yards of the firing position. These loose tracer elements were visible to personnel 1500 yards forward of the gun position. (Test No. 6)

W. S. SINCLAIR, JR.
Major, Infantry,
Test Officer.

I concur in the above record of test.

EDWARD B. CROSSMAN,
Lt. Colonel, Infantry,
Test Section Executive.